



MedCOF workshop 2015

Drivers of mid-latitude seasonal forecasts

J. García-Serrano (BSC-ES)

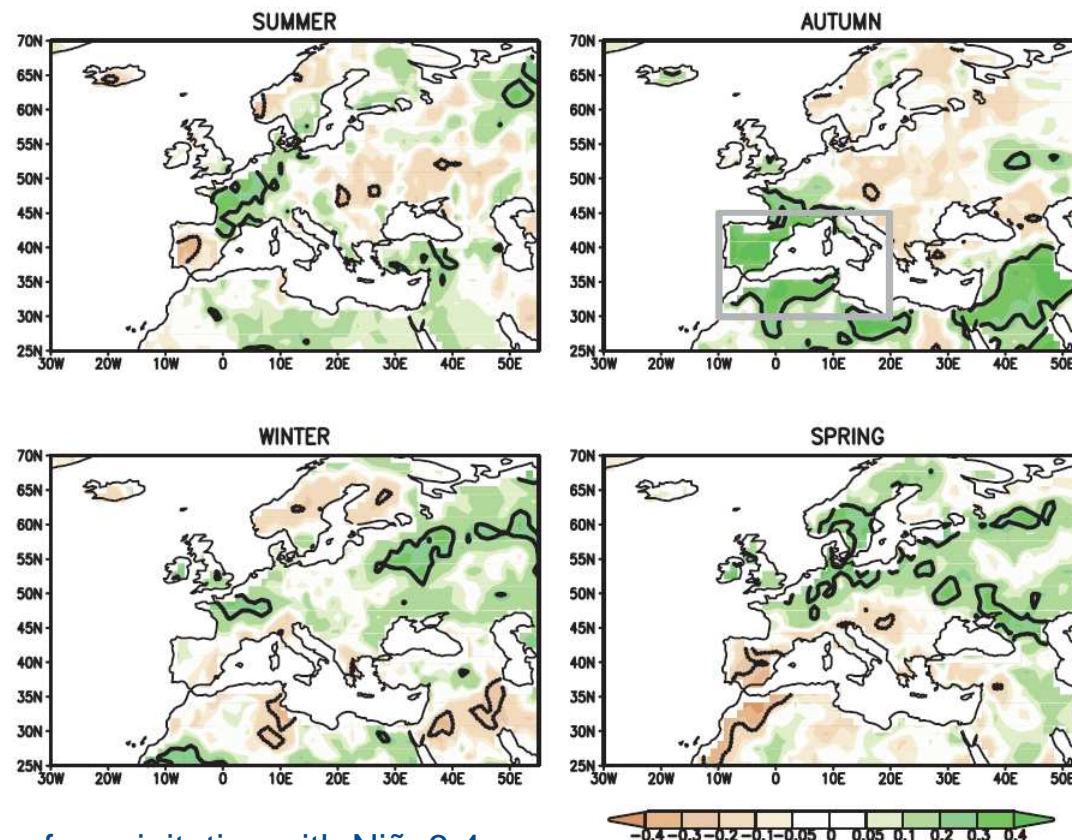
Drivers of mid-latitude seasonal forecasts

- Spring
- Summer
 - Pacific Ocean – ENSO
 - Atlantic Ocean
 - Mediterranean Sea
 - Soil moisture
 - Arctic sea ice
- Autumn
- Winter
 - Pacific Ocean - ENSO
 - Atlantic Ocean
 - Eurasian snow
 - Arctic sea ice

ENSO is the leading mode of climate variability on seasonal-to-interannual timescales

ENSO is the most important source of predictability at seasonal timescales

[e.g. Doblas-Reyes et al. 2013]

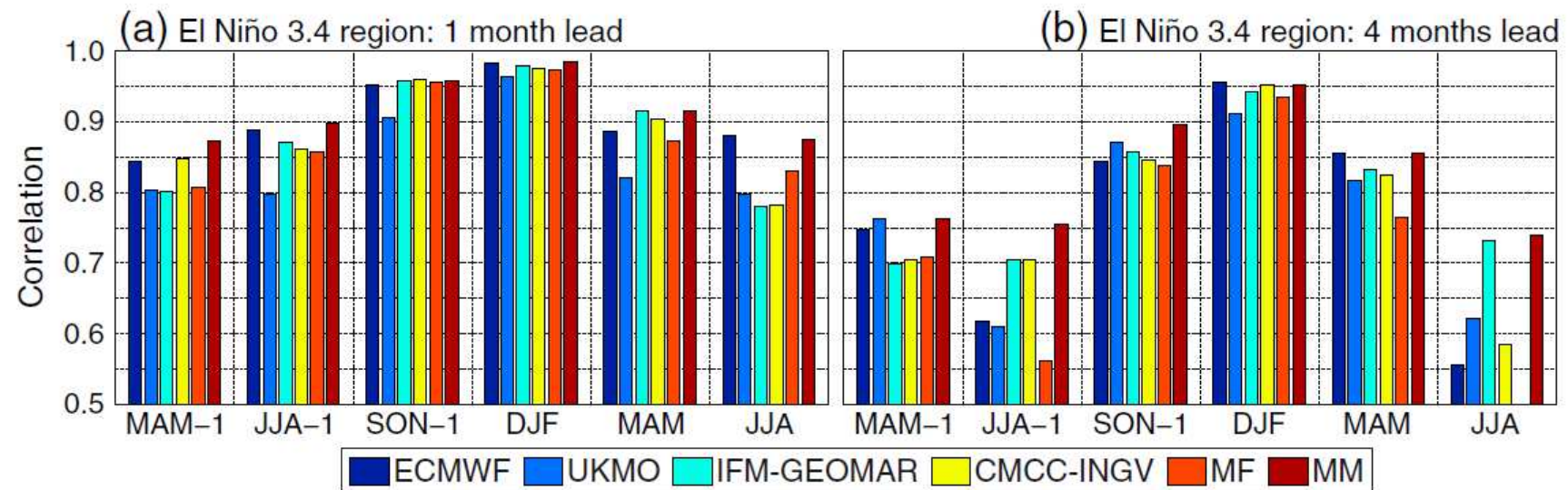


correlation maps of precipitation with Niño3.4
[Mariotti et al. 2002]

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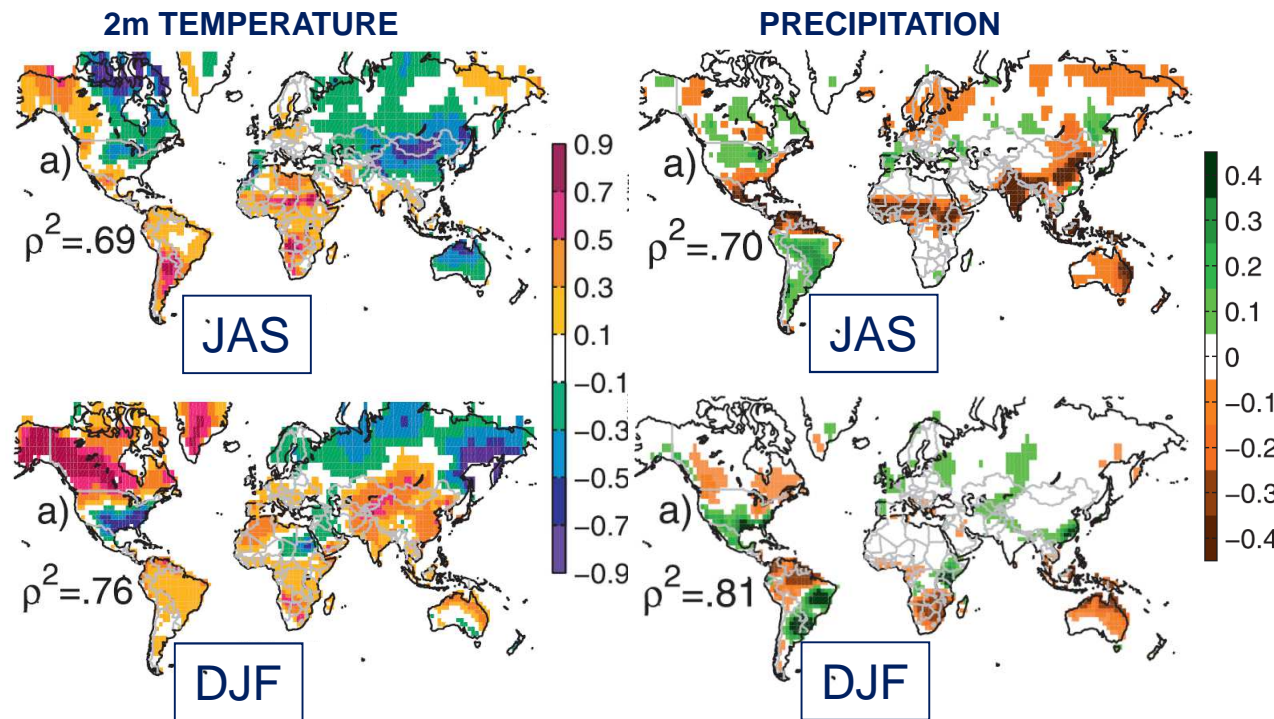
correlation skill of Niño3.4 in ENSEMBLES

[Manzanas et al. 2014]

ENSO is the leading mode of climate variability on seasonal-to-interannual timescales

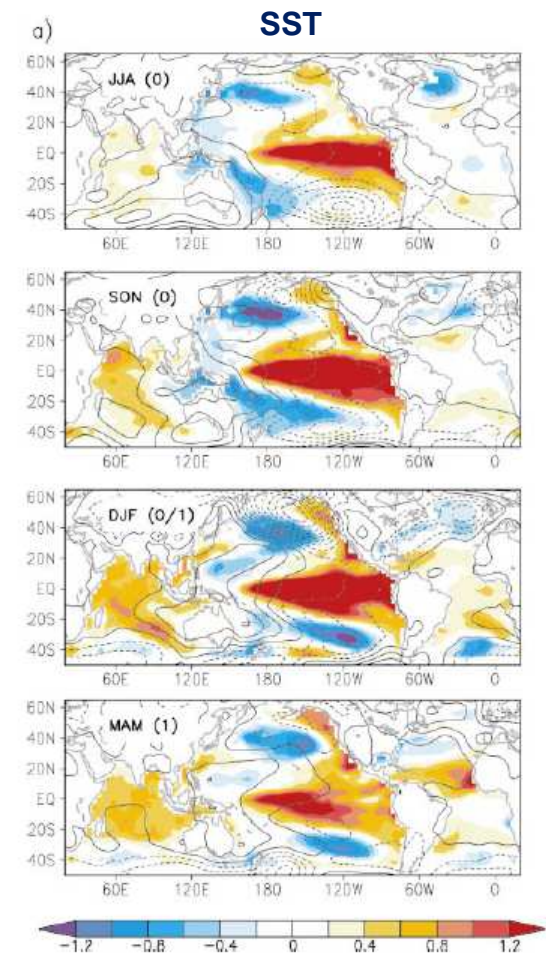
ENSO is the most important source of predictability at seasonal timescales

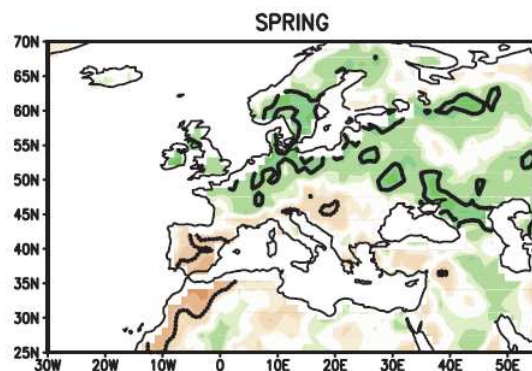
[e.g. Doblas-Reyes et al. 2013]



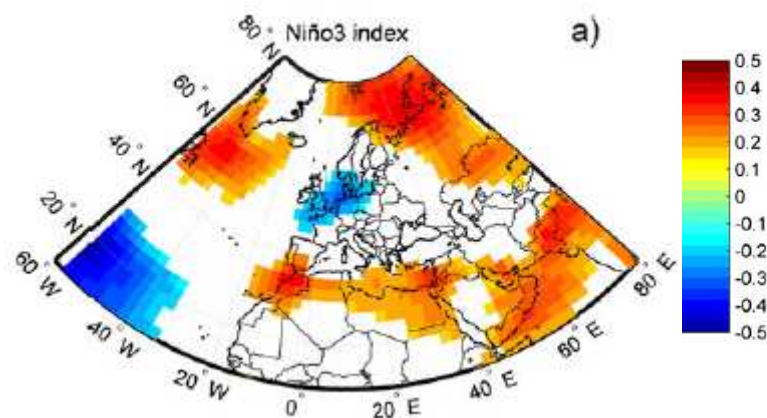
ENSO teleconnections: regressions onto Niño3.4

[Yang and DelSole 2012; Alexander et al. 2002]



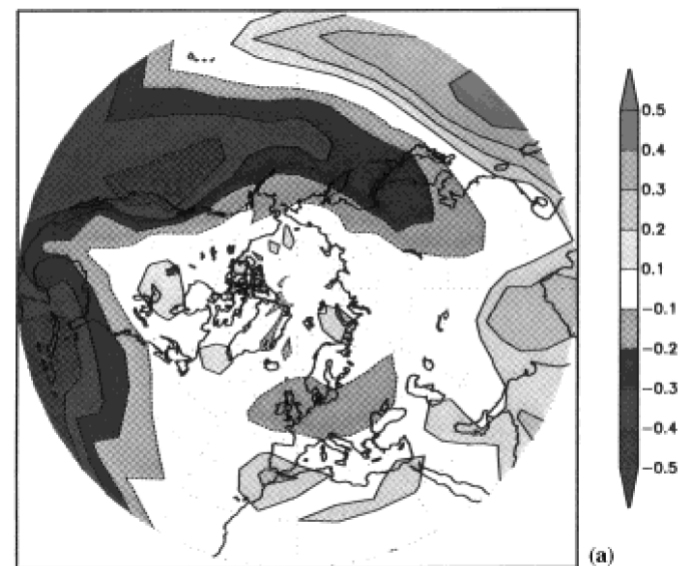


correlation map of precipitation with Niño3.4
[Mariotti et al. 2002]

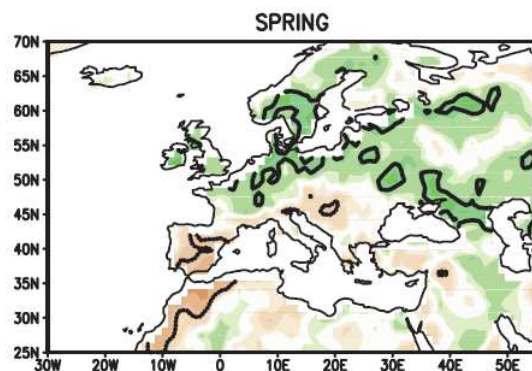


correlation map of MAM-SLP with DJF-Niño3
[Lorenzo et al. 2011]

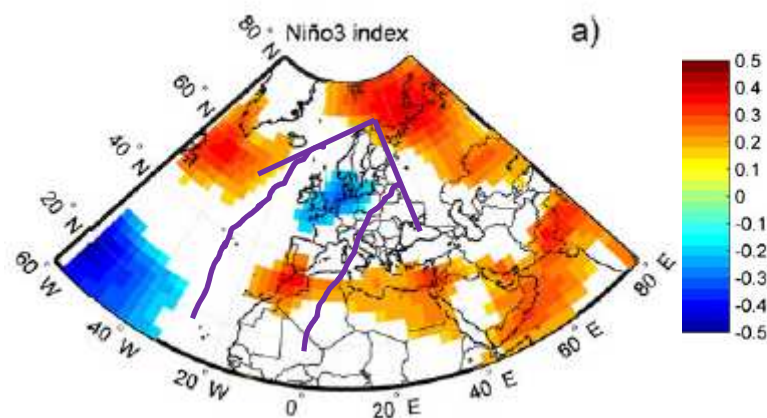
SPRING



correlation map of SLP with Niño3 (in MAM)
[van Oldenborgh et al. 2000]

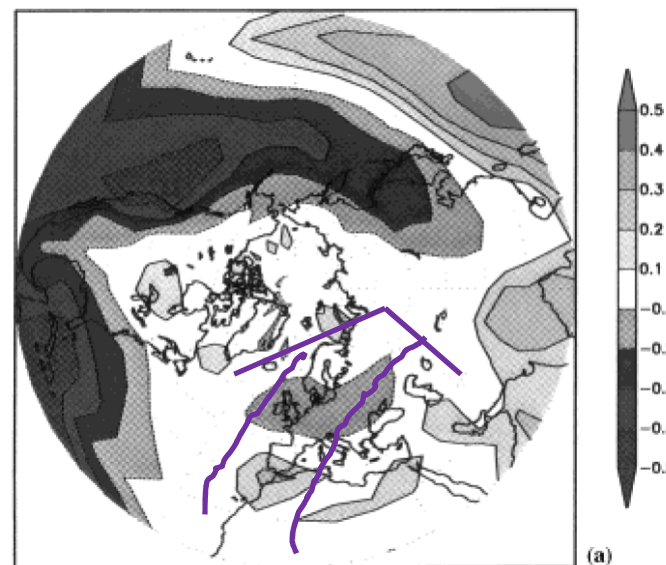


correlation map of precipitation with Niño3.4
[Mariotti et al. 2002]

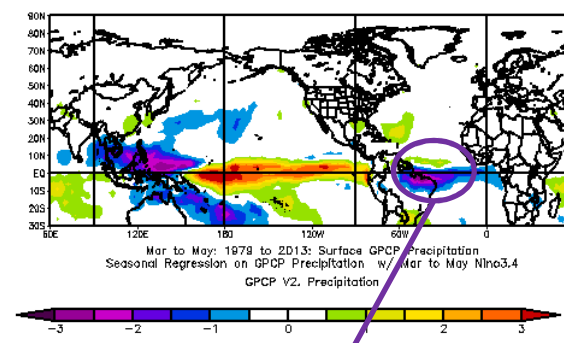


correlation map of MAM-SLP with DJF-Niño3
[Lorenzo et al. 2011]

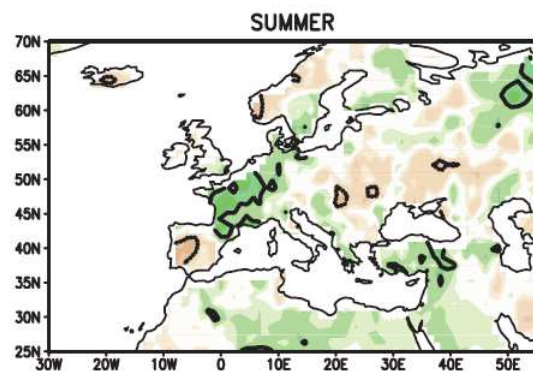
SPRING



correlation map of SLP with Niño3 (in MAM)
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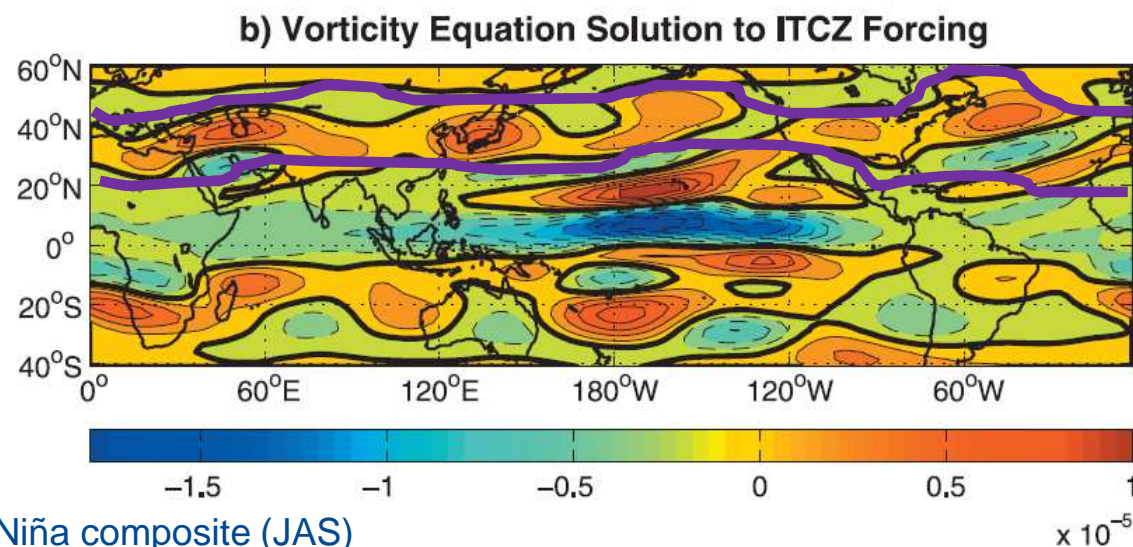


secondary Rossby wave source



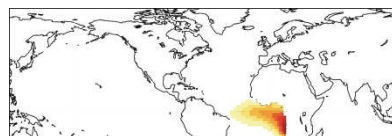
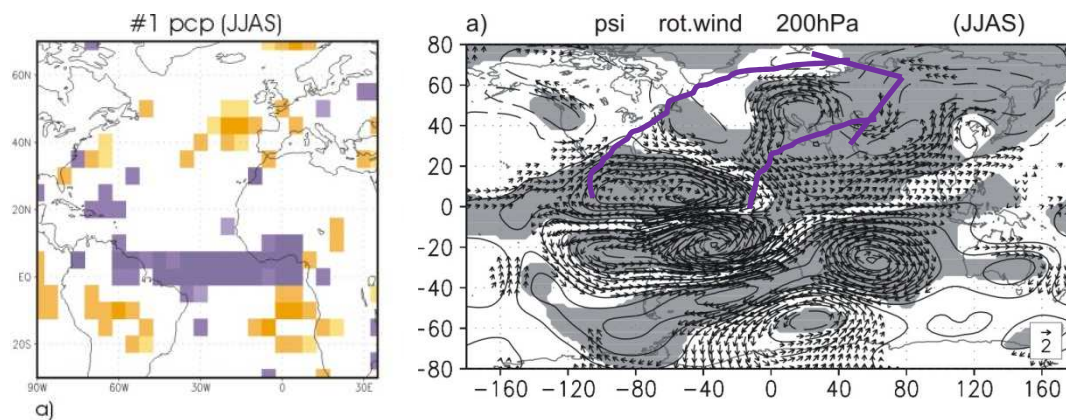
SUMMER

correlation map of precipitation with Niño3.4
[Mariotti et al. 2002]



resembling El Niño-La Niña composite (JAS)
[Shaman and Tziperman 2007]

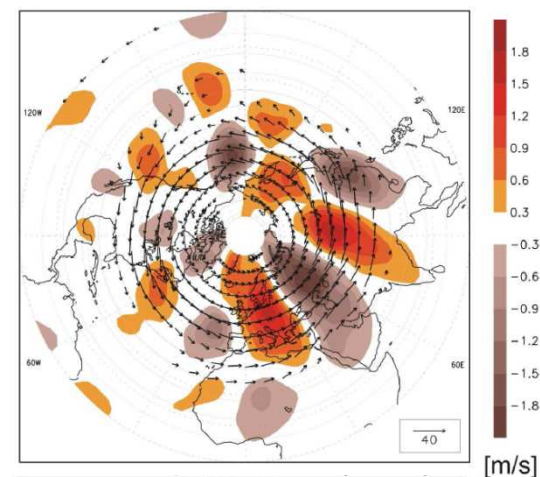
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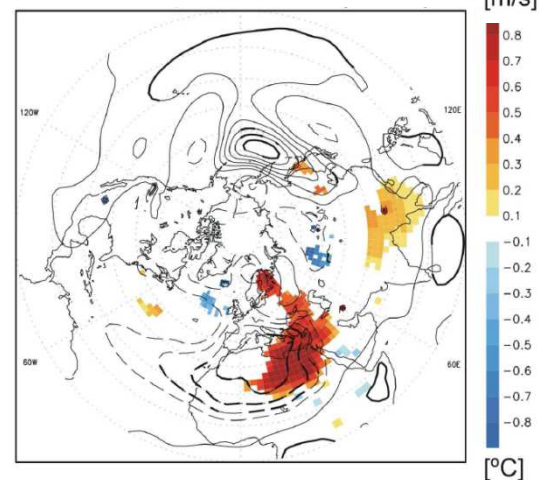
Atlantic Niño

[García-Serrano et al. 2008; 2011a]

V200_anom + U200_clim



PSI850_anom + T850_clim



eastern Mediterranean SST anomalies

[García-Serrano et al. 2013]



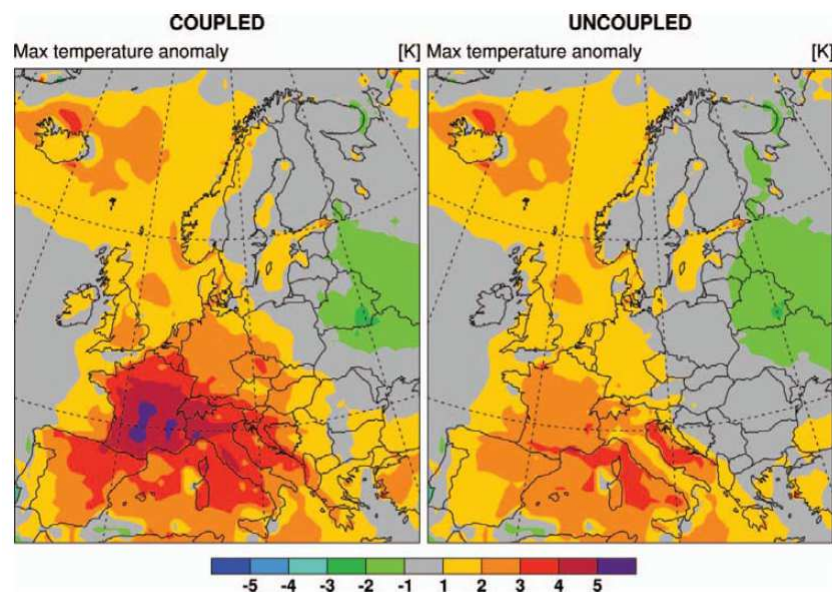
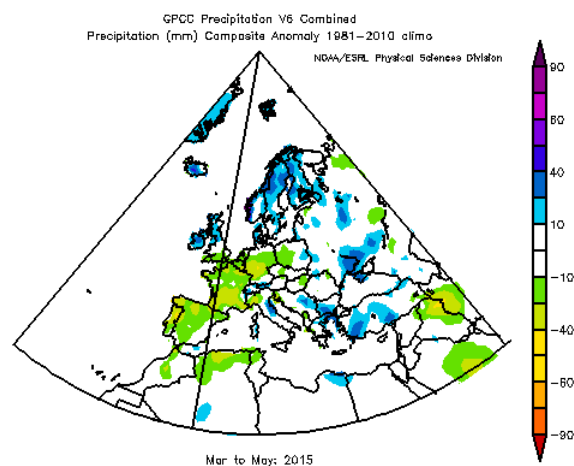
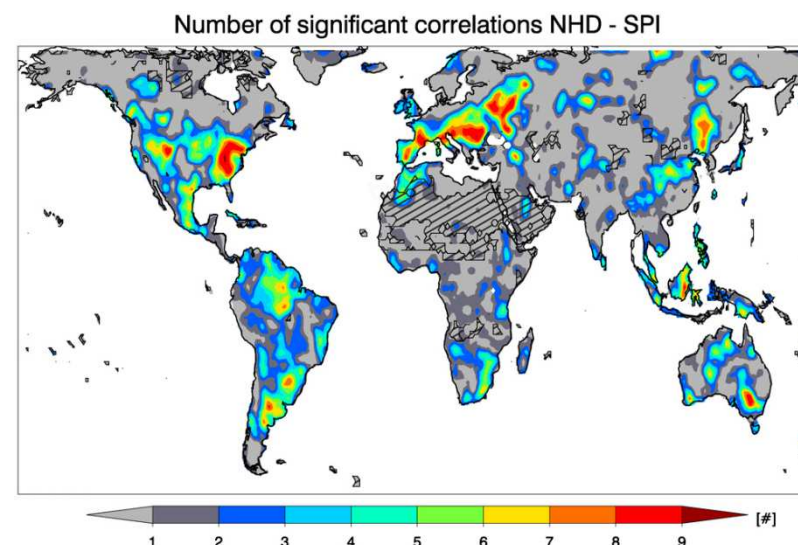


FIGURE 8. Average daily maximum temperature (at 2 m) anomalies in JJA 2003 in a regional climate simulation (CHRM model) with a fully interactive land surface scheme (left) and with prescribed climatological mean soil moisture conditions (see Fischer et al., 2007b, for details on the experimental setup). The anomalies were averaged for summer (JJA) 2003 wrt to a model climatology 1970–2000.

[García-Herrera et al. 2010]



SUMMER

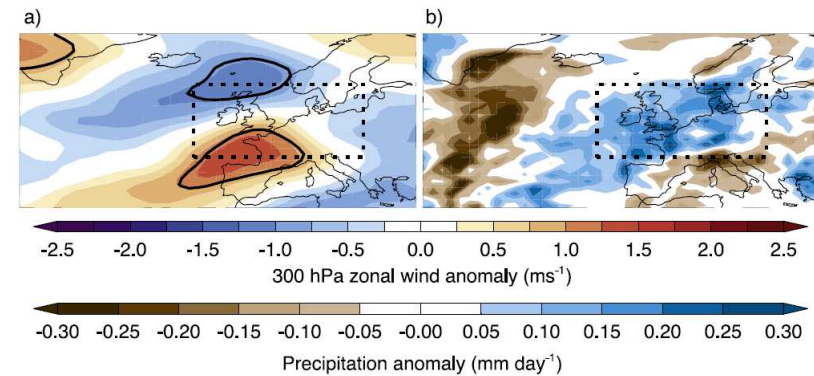
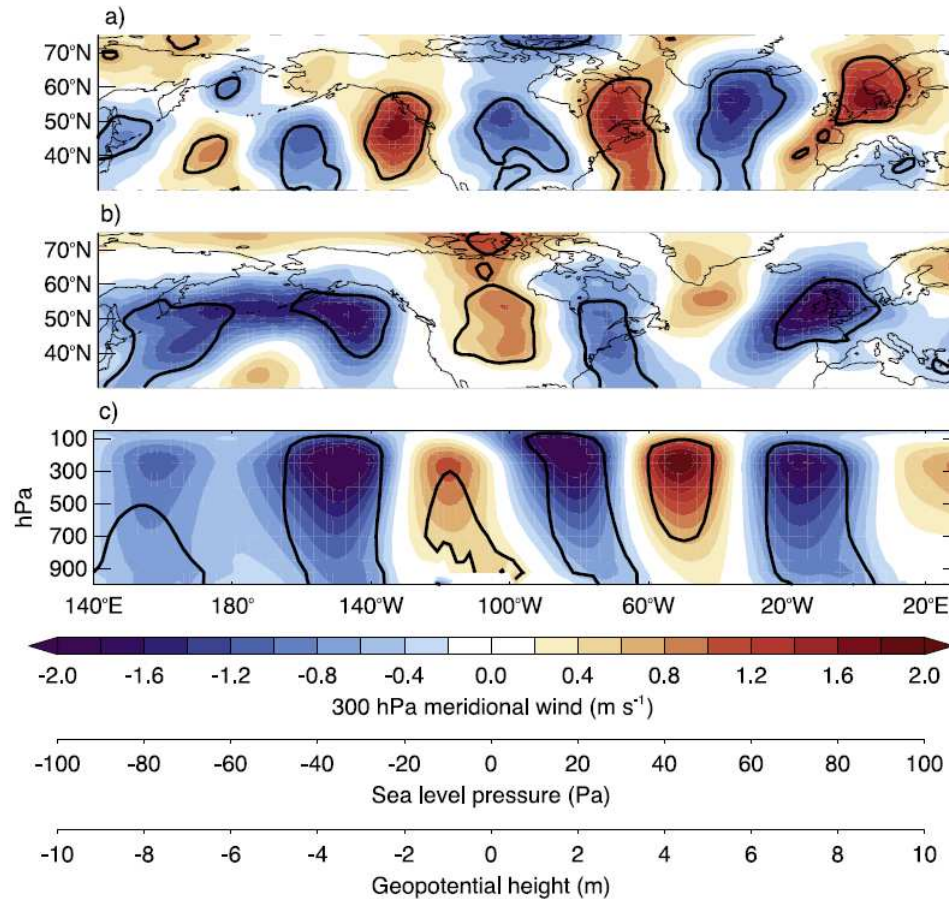


[Mueller and Seneviratne 2012]

soil moisture could provide more accurate forecasts

soil moisture feedback,
relevant for seasonal predictability
[Douville and Chauvin 2000; Douville 2010]

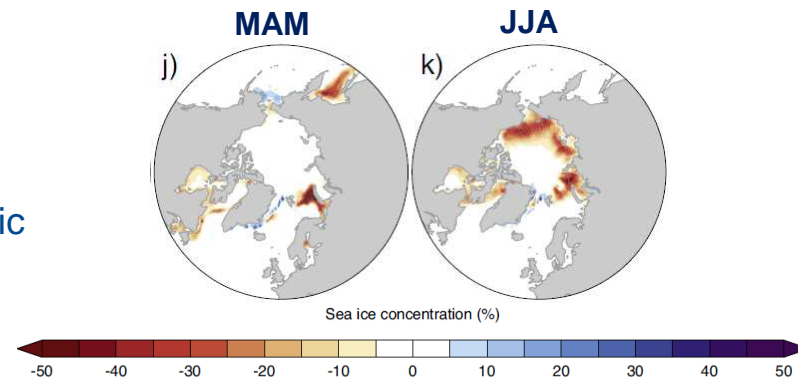
SUMMER

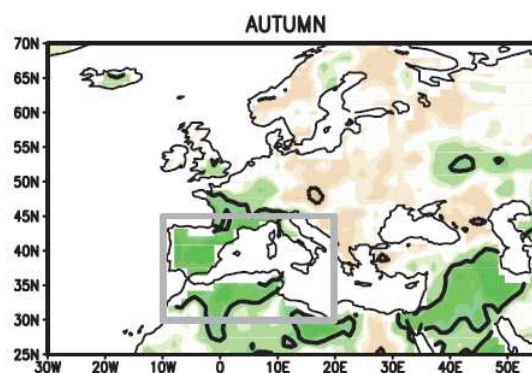


sea-ice reduction linked to weakening
of the North Atlantic westerly-jet

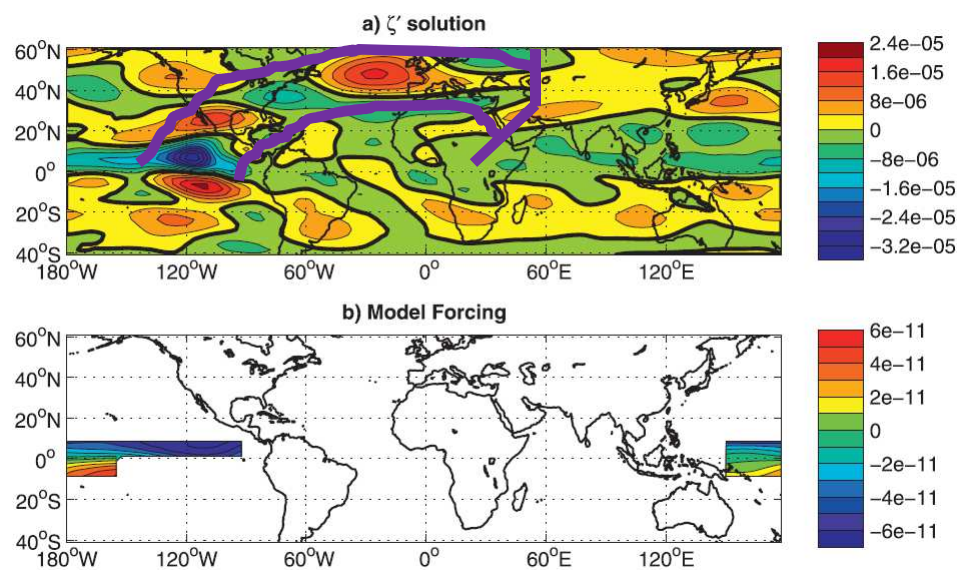
Arctic sea-ice is also a precursor for summer atmospheric
circulation and rainfall anomalies over Europe

[Screen 2013]



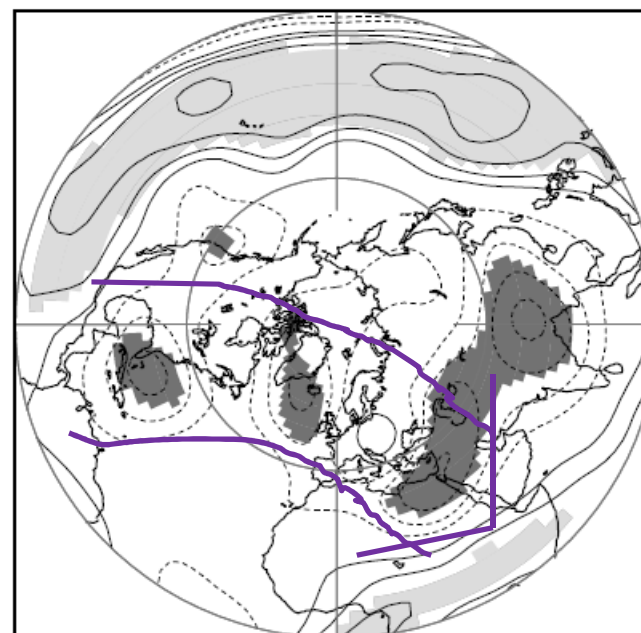


correlation map of precipitation with Niño3.4
[Mariotti et al. 2002]

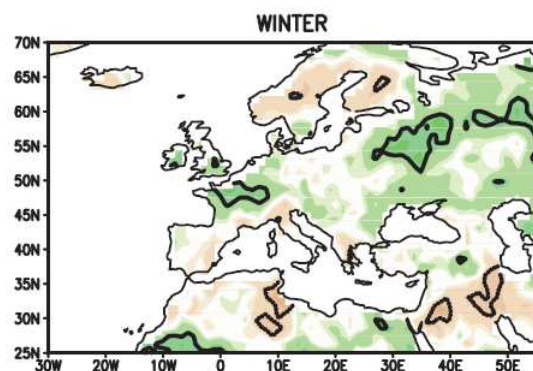


[Shaman and Tziperman 2011]

AUTUMN

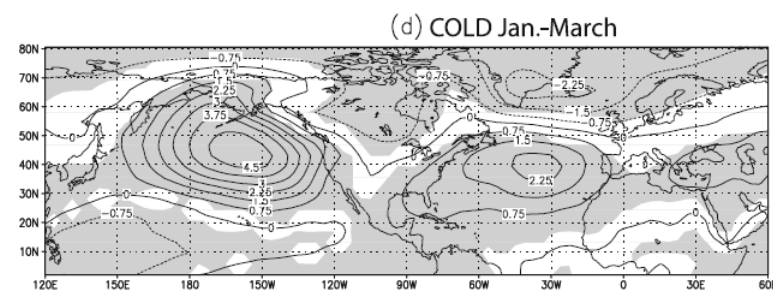
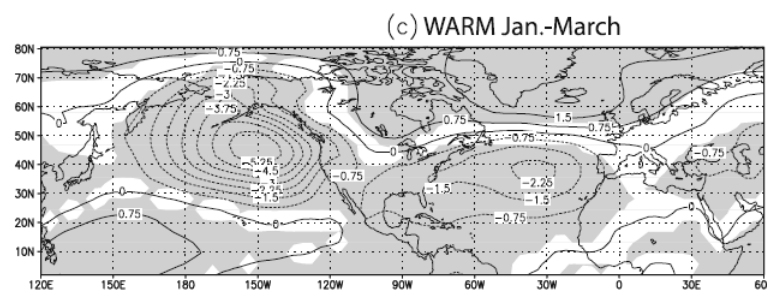
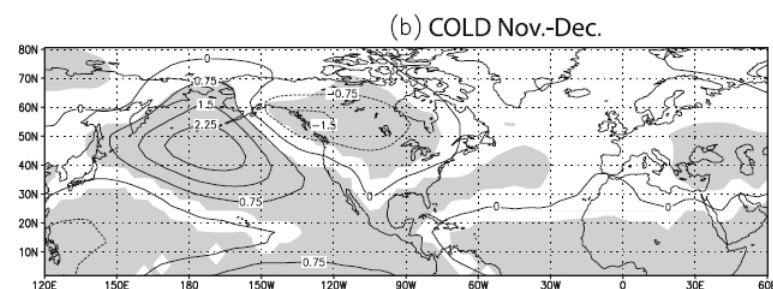
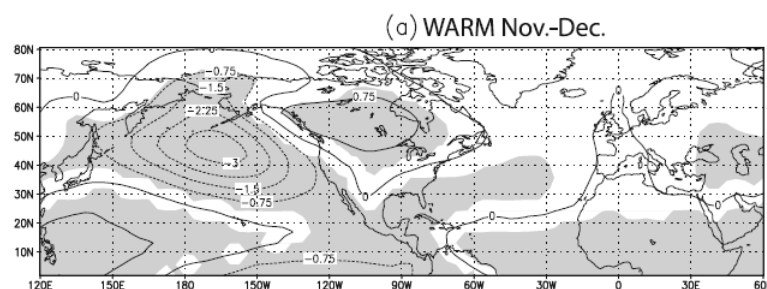


composite of PSI200 linked to El Niño
[Mariotti et al. 2005]

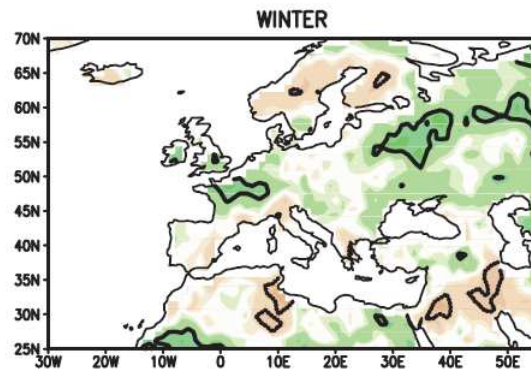


WINTER

correlation map of precipitation with Niño3.4
[Mariotti et al. 2002]

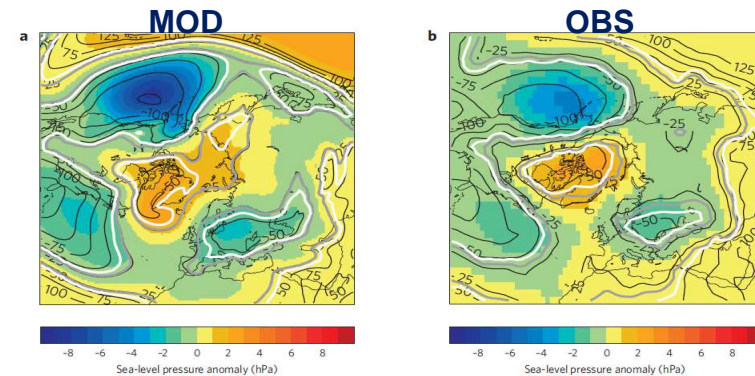


strong intra-seasonal modulation of the ENSO teleconnection: early-winter (ND) vs mid/late-winter (JFM)
[Gouirand et al. 2007]

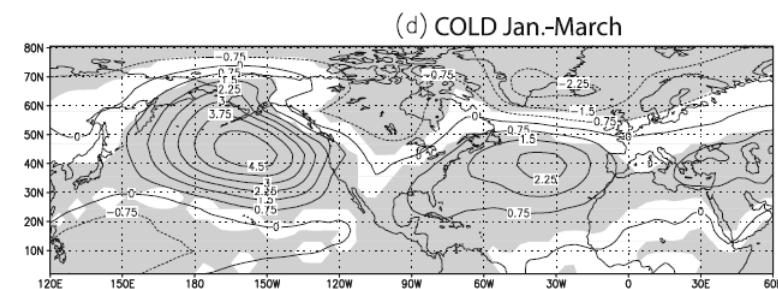
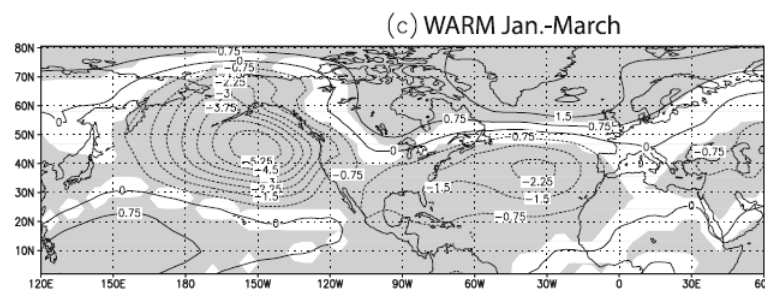
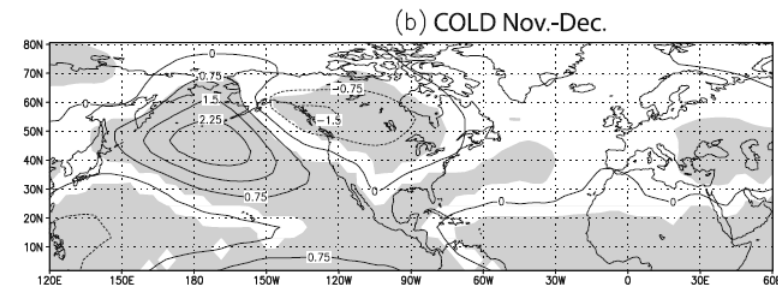
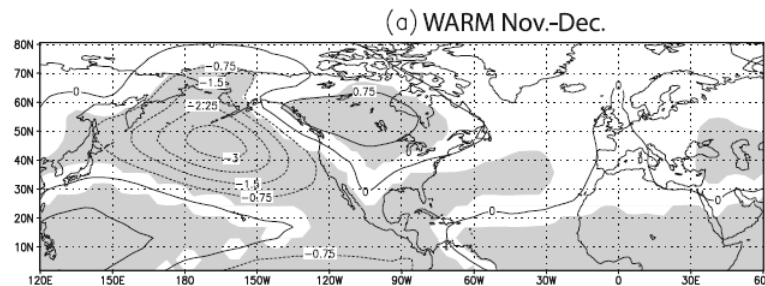


correlation map of precipitation with Niño3.4
[Mariotti et al. 2002]

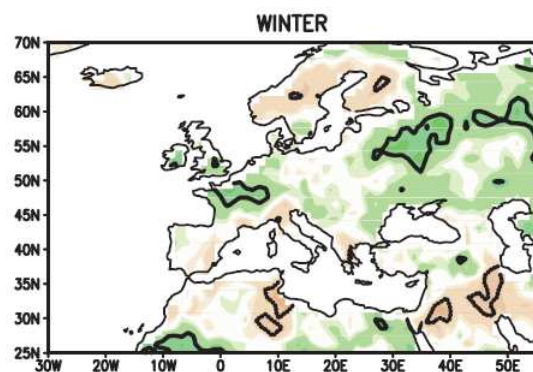
WINTER



canonical signature in JFM [Ineson and Scaife 2009]

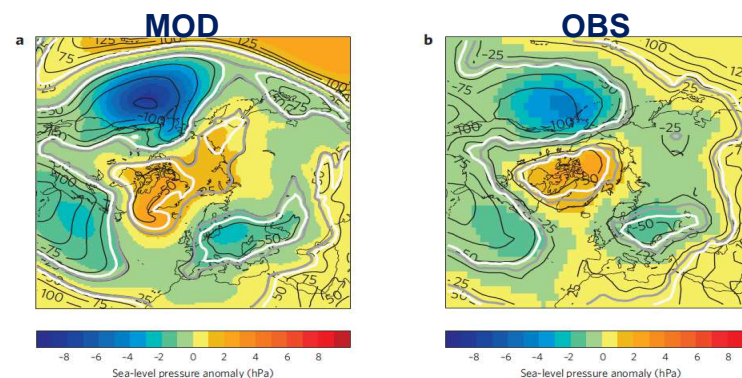


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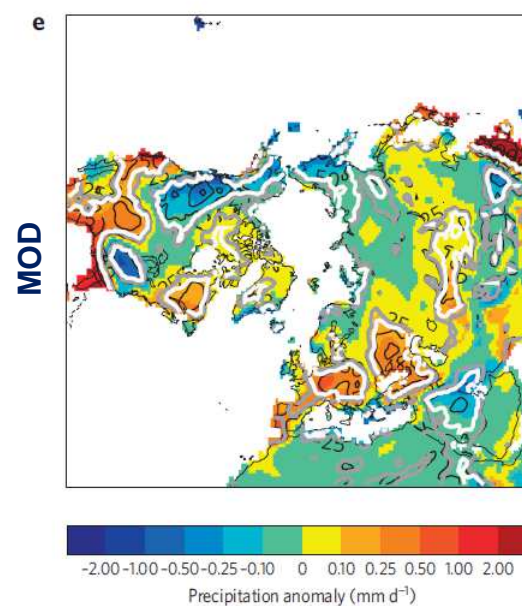
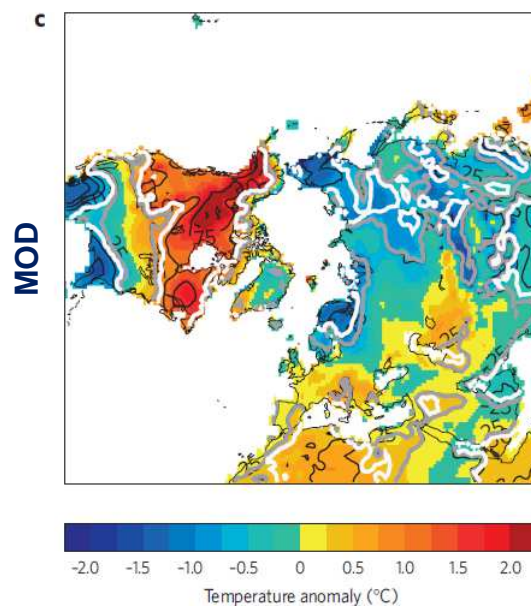


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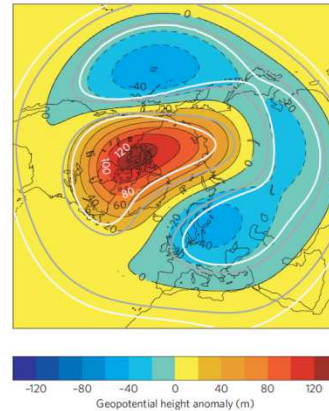


[Ineson and Scaife 2009]

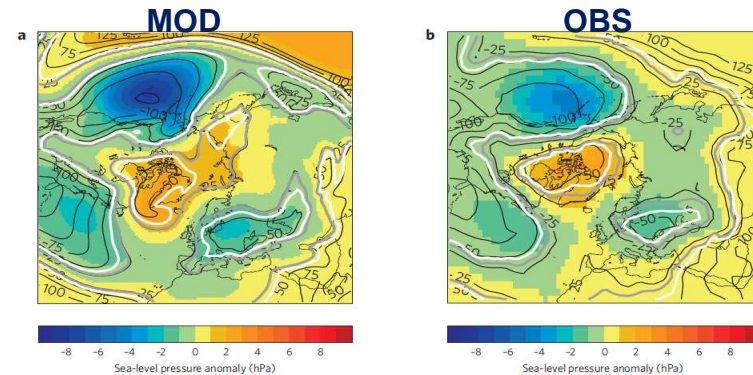
JFM: linear, robust and stationary over the past 300 years [review by Brönnimann 2007]

Z50 (lower stratosphere)

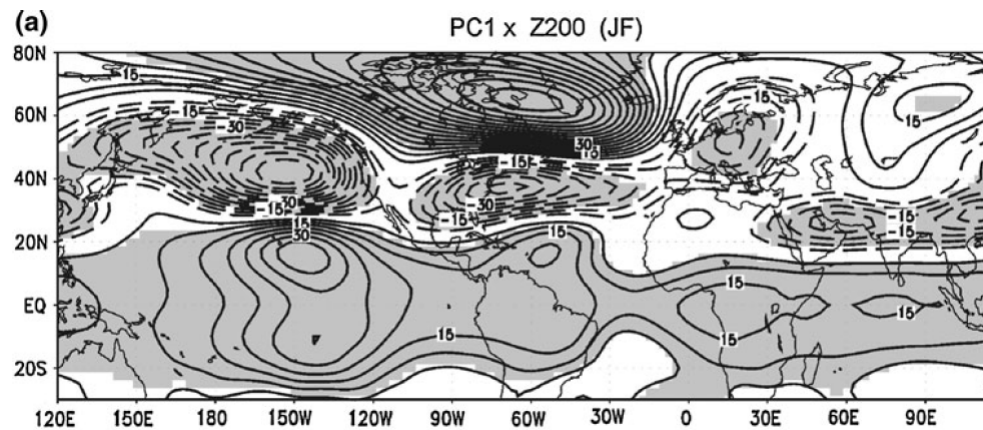
weakened polar vortex
[Ineson and Scaife 2009]



WINTER

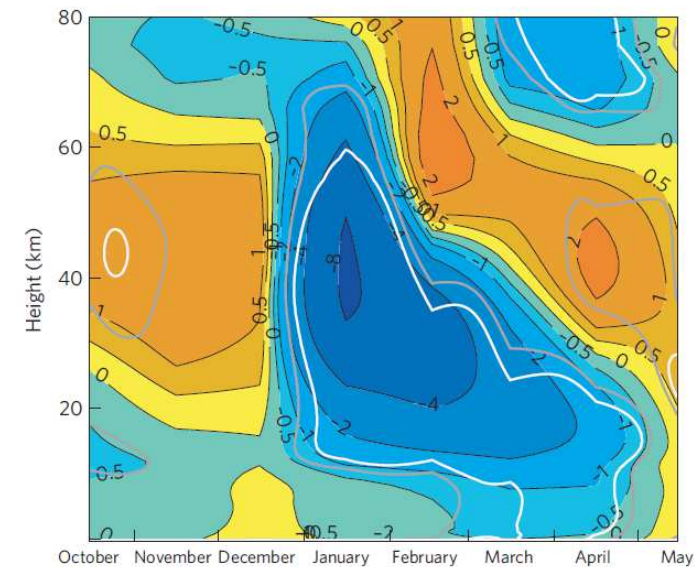


canonical signature in JFM [Ineson and Scaife 2009]



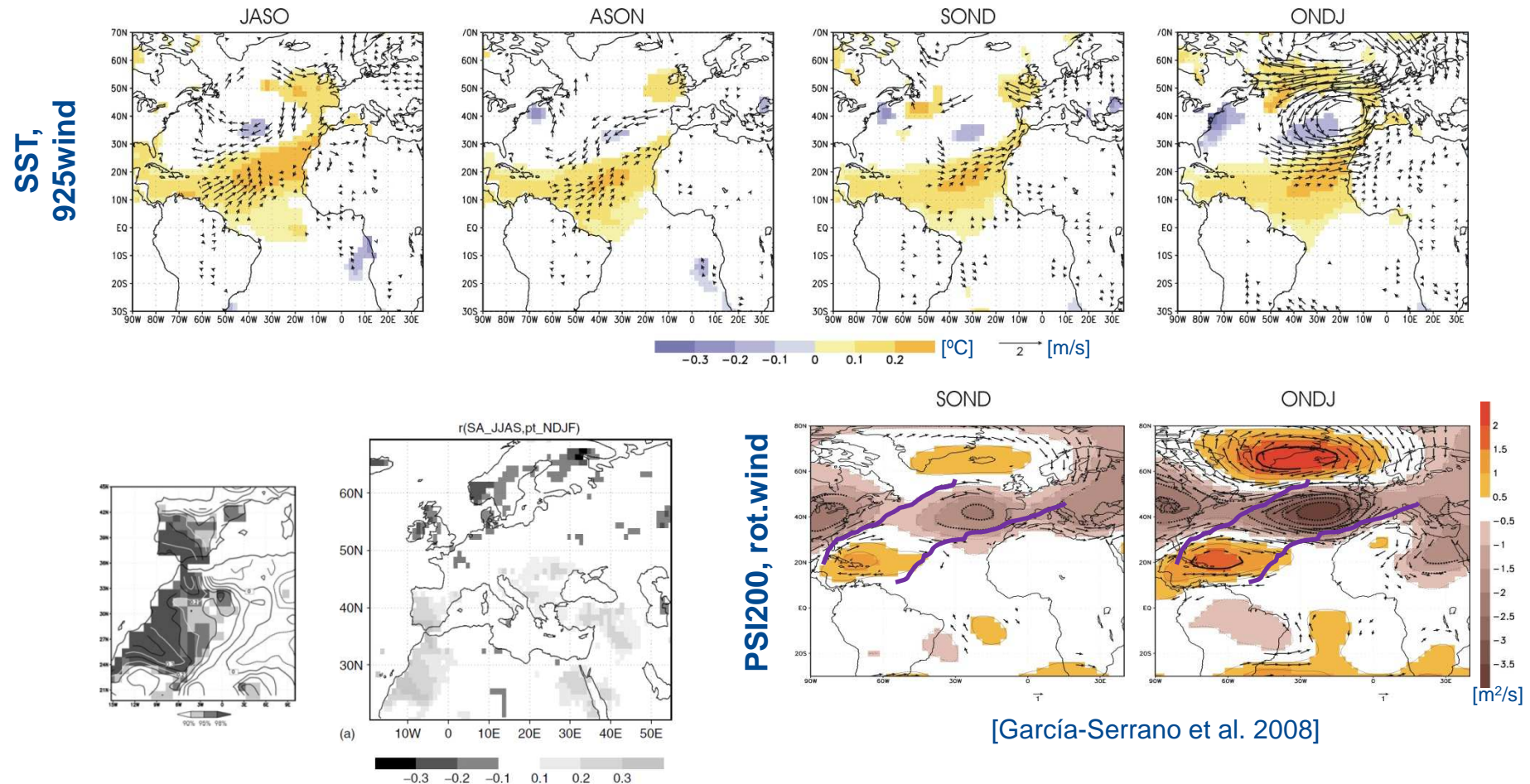
tropospheric pathway
[García-Serrano et al. 2011b]

stratosphere as feedback for atmospheric persistence
[Cagnazzo and Manzini 2009]



stratospheric pathway
[Ineson and Scaife 2009]

WINTER



subtropical North Atlantic SST – predictor of winter
European/North African precipitation

[Rodríguez-Fonseca and Castro 2002; Rodríguez-Fonseca et al. 2006]

retained ITCZ + triggering Rossby wave
[Terry and Cassou 2002]

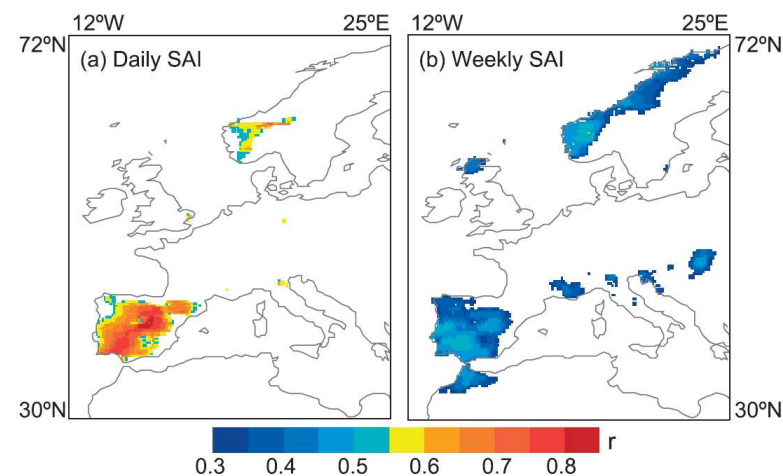
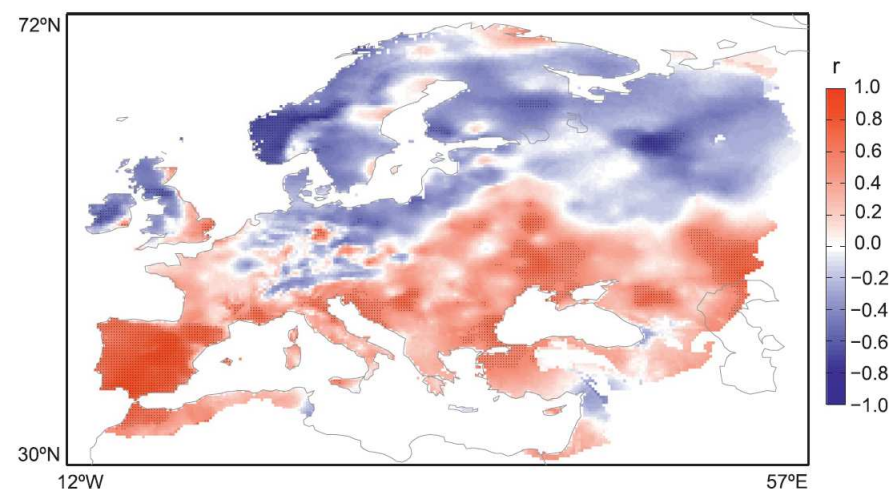
Eurasian snow cover in autumn (OCT)

[Cohen and co-authors]

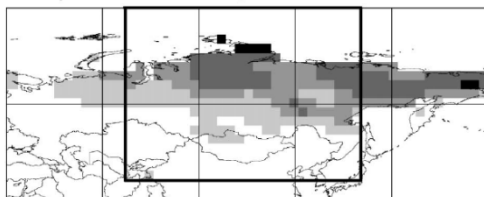
snow advance index - SAI / $r(\text{AO})=0.6-0.8$

[Cohen and Jones 2011]

WINTER



a) October Snow Depth - CTRL Simulation



[Gong et al. 2003]

correlation / empirical prediction skill

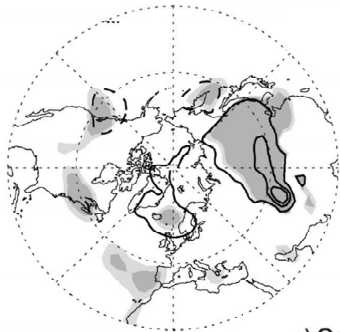
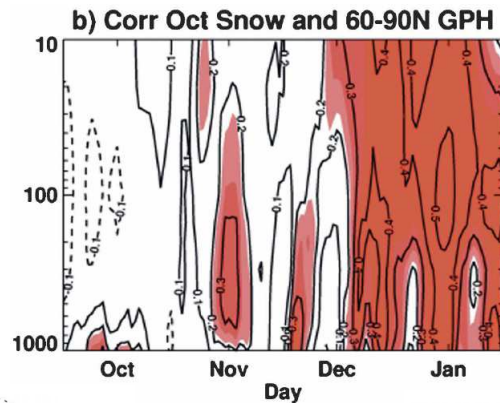
[Brands et al. 2012]

Eurasian snow cover in autumn (OCT)

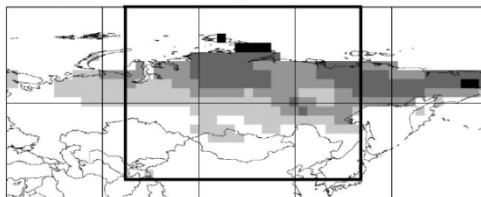
[Cohen and co-authors]

snow advance index - SAI / $r(\text{AO})=0.6-0.8$

[Cohen and Jones 2011]

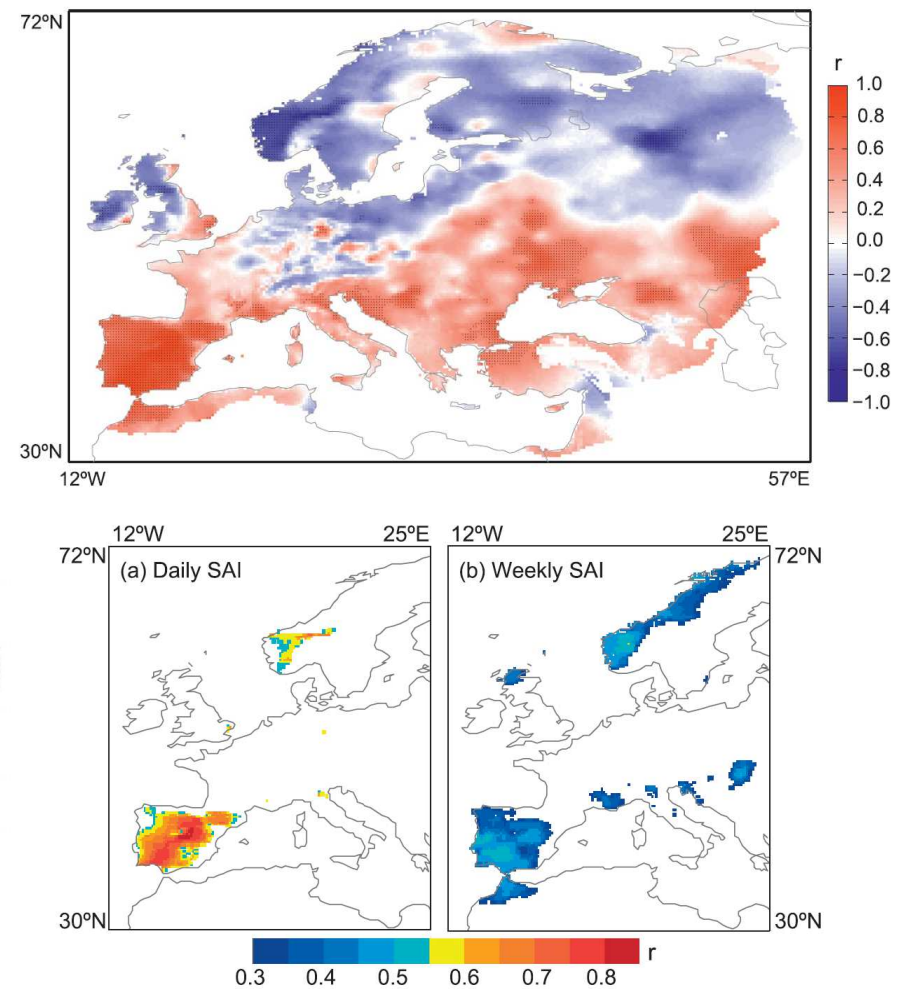


a) October Snow Depth - CTRL Simulation



[Gong et al. 2003; Cohen et al. 2007]

WINTER

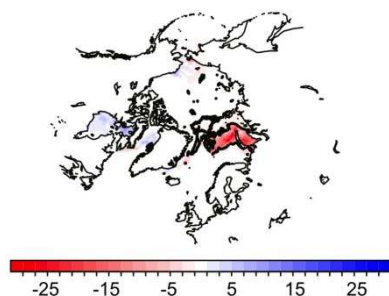


correlation / empirical prediction skill

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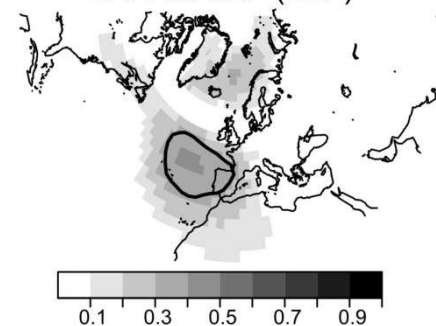
Barents-Kara sea-ice concentration in autumn (NOV)
[García-Serrano et al. 2015; King et al. 2015; Koenig et al. 2015]
[Scaife et al. 2014]

a) **MCA-SIC/BK_{NOV} X SIC (nov)**

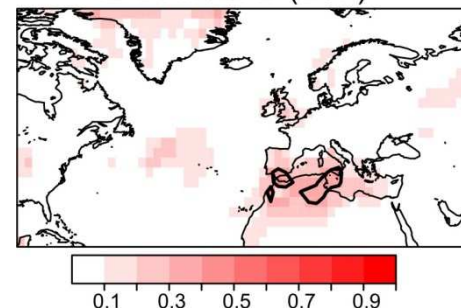


WINTER

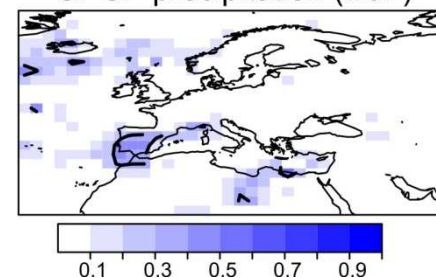
ERA-int SLP (DJF)



ERA-int SAT (DJF)



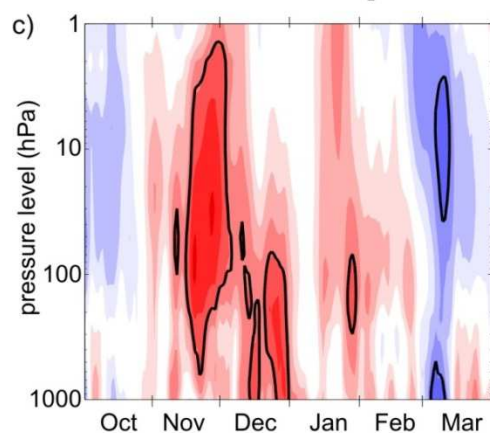
GPCP precipitation (DJF)



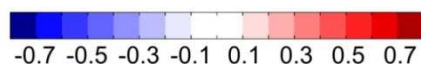
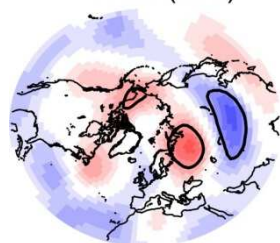
empirical prediction skill
[García-Serrano et al. 2015]

Barents-Kara sea-ice concentration in autumn (NOV)
[García-Serrano et al. 2015; King et al. 2015; Koenig et al. 2015]
[Scaife et al. 2014]

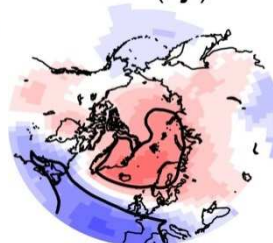
MCA-SIC/BK_{NOV} X HGT [60N-90N]



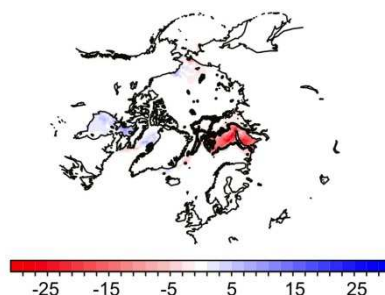
Z200 (nov)



SLP (djf)

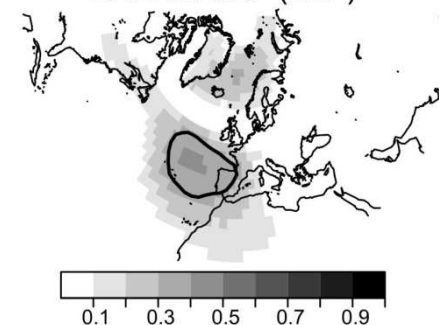


a) MCA-SIC/BK_{NOV} X SIC (nov)

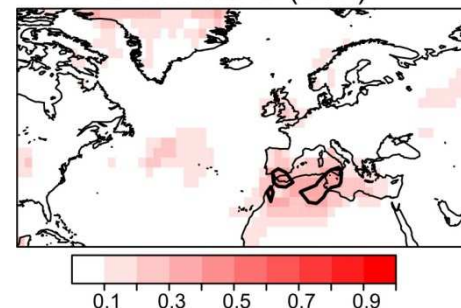


WINTER

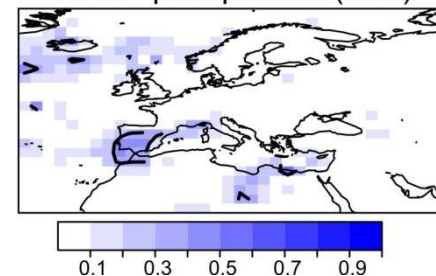
ERA-int SLP (DJF)



ERA-int SAT (DJF)



GPCP precipitation (DJF)

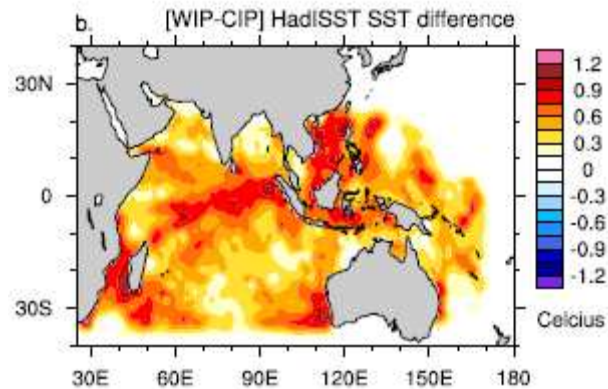


empirical prediction skill
[García-Serrano et al. 2015]



SUMMARY:

- ENSO is the most important source of predictability at seasonal time-scales...
 - ...other oceanic basins may also provide predictability (e.g. Indian Ocean)
 - ...other forcings may play a larger role in seasons when ENSO signal is weak
 - ...other atmospheric phenomena might be important (e.g. MJO; QBO)
- dynamical forecast systems will require a proper representation of stratosphere
- there is room for comprehensively improving empirical prediction models



Indian Ocean in winter

[Sanchez-Gomez et al. 2008]

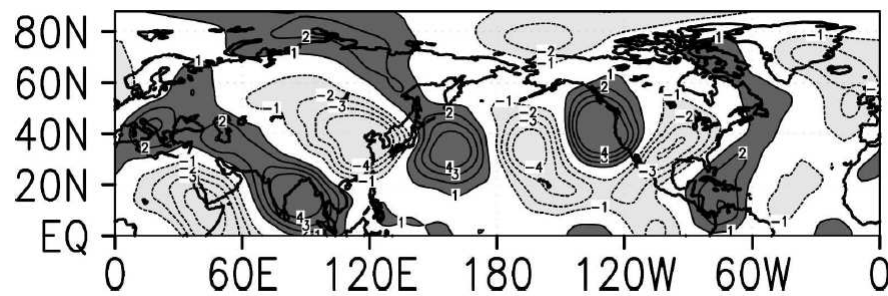
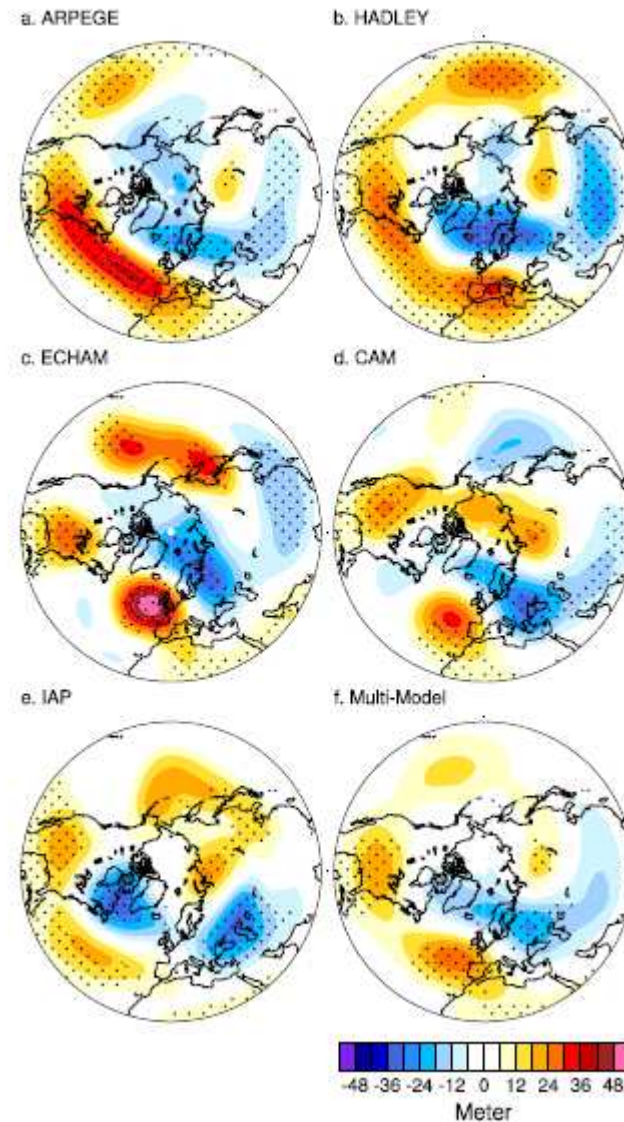
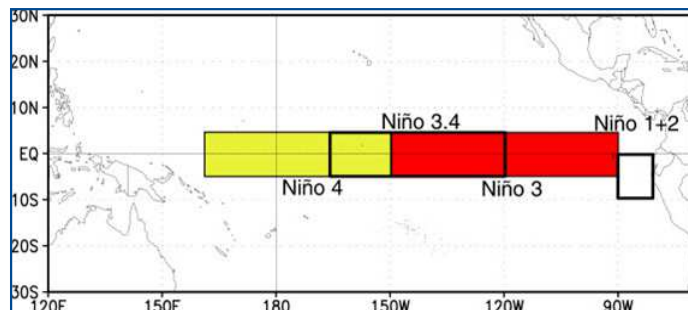


FIG. 14. Meridional 300-hPa winter (DJF) wind response for the “western Indian Ocean

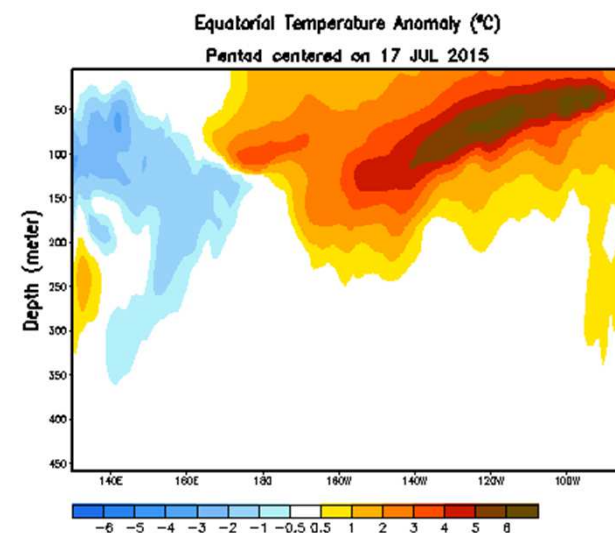
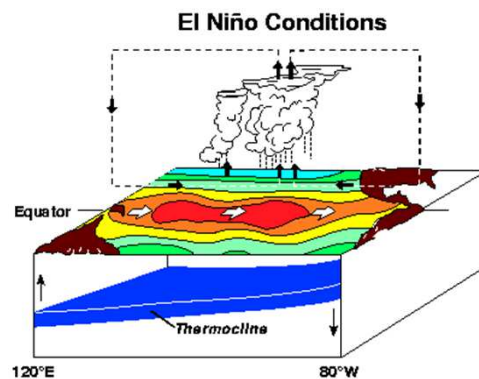
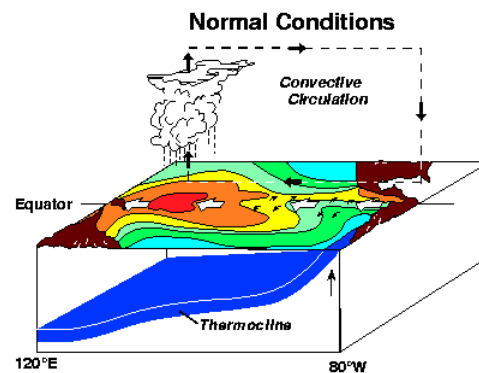
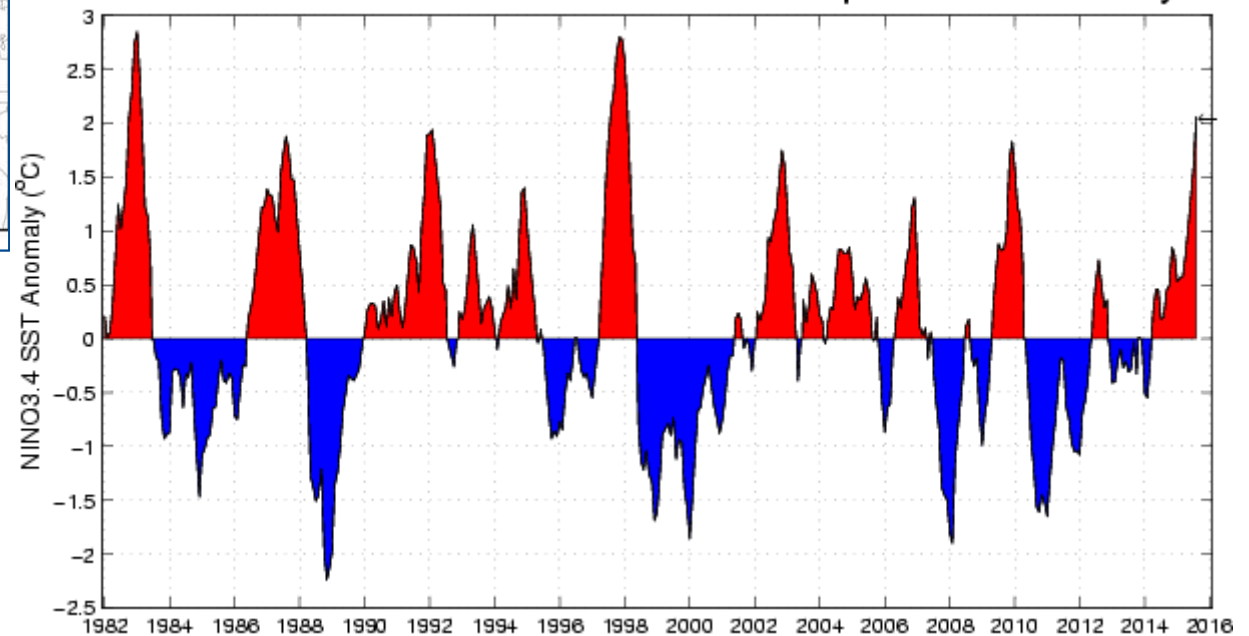
[Bader and Latif 2005]

[WIP-CIP] difference for DJF Z500





Historical NINO3.4 Sea Surface Temperature Anomaly



MCA-SIC/BK_{NOV}

SLP (dec)

SLP (jan)

SLP (feb)

SLP (djf)

